High Power MPPT Solar Charge Controller Request for Proposal (RFP) Template

For Morningstar GenStar MPPT (12/24/48V) Controllers

Models:
GS-MPPT-60M-200V
GS-MPPT-80M-200V
GS-MPPT-100M-200V

Choosing the right charge controller is one of the most important decisions associated with designing and building an off-grid system. This sample template was created to help installers, designers, and engineering, procurement & construction personnel create an RFP that will attract responses from qualified parties that can meet key high power MPPT charge controller specifications to help ensure deployment of a reliable, high-quality off-grid system. A charge controller is considered to be the brain of a Photovoltaic (PV) system and an ineffective controller can cause premature battery failure and failure in the whole system.

System Sizing Quick Reference Table:
Use the following table as a quick reference guide for system sizing for GenStar MPPT controller selection.

MODELS	**GS-MPPT-60M-200V**			**GS-MPPT-80M-200V**			**GS-MPPT-100M-200V**		
Maximum Charge Current	**60A**			**80A**			**100A**		
Nominal System Voltage	12V	24V	48V	12V	24V	48V	12V	24V	48V
Nominal Maximum Output Power	800W	1600W	3200W	1075W	2150W	4300W	1350W	2700W	5400W
Recommended Max PV Array Sizing*	**1050W**	**2100W**	**4200W**	**1400W**	**2800W**	**5600W**	**1750W**	**3500W**	**7000W**
Maximum PV Array Sizing	1200W	2400W	4800W	1600W	3200W	6400W	2000W	4000W	8000W
Maximum Load Current	**30A**			**30A**			**30A**		
Maximum Load Power	330W	660W	1320W	330W	660W	1320W	330W	660W	1320W
Maximum PV Array Input Voltage	200V (Max Voc @ coldest record temperature)								

* Exceeding the Nominal Maximum Output Power may not be recommended for very hot climates and higher voltage arrays > 150V.

General

- The controller design life shall be 15 years or greater.
- The manufacturer's warranty period shall be 5 years.
- The manufacturer shall have been present in the international market for at least 10 years.
- Charge controllers shall be based on Maximum Power Point Tracking (MPPT) technology.
- The controller shall include LED's which indicate faults, load state and battery charge states.
- The controller shall include a built-in digital display for monitoring, control and custom programming.
- The controller shall include BlueTooth communications and there shall be a mobile app available for monitoring and control.
- The controller shall include a communications interface for remote monitoring, control and custom programming.
- The controller shall include built-in DC load control.

- The Controller shall include an internal Clock that retains the time with the use of a cell battery when the Controller is not powered on.

Electrical Characteristics

- Voltage accuracy must be < 80 mV. Controllers which do not list accurate information will not be accepted. The controller must come from the factory calibrated for voltage accuracy. Controllers that require calibration during installation will not be accepted..
- Shall support 12V, 24V or 48V systems
- The maximum continuous output charge current shall be equal or higher than 60 Amps, 80 Amps or 100 Amps.
- The controller's built-in load control shall have a maximum load current of 30 Amps or greater.
- Shall have a Self-Consumption no greater than 3 Watts

Charging

- The maximum allowable open circuit PV array voltage adjusted for coldest conditions shall be 200V.
- The peak efficiency must be higher than 99%.
- Must support 4 stage charging - Bulk, Absorption, Equalize (Boost) and Float
- Depending on the type of battery (typically for AGM or flooded batteries), the controller shall provide an equalization (boost) charge stage to automatically take place every 28 days (or a programmable # of days) or there must be an option for manual equalization.
- Depending on the charging requirements of the battery or system, the battery settings must be fully programmable allowing the adjustment of charge absorption, float and equalization voltages and times and battery temperature compensation settings.
- The custom programmability must be able to support the type of battery (gel, sealed or flooded lead acid batteries, lithium (LFP) or other battery types) and system parameters (usage and system parameters).
- Battery custom settings can be saved to a configuration file and rapidly deployed to multiple controllers.
- The controller shall include a remote temperature sensor (RTS).
- The thresholds for all the battery charging voltage settings (absorption, float, and equalize), must be temperature compensated and adjustable. The default temperature compensation coefficient = -30mV/C @12V, -60mV/C @24V and -120mV/C @48V. Custom temperature compensation coefficient settings must be available according to the battery manufacturer's requirements.
- Minimum and maximum temperatures for temperature compensation must also be able to be custom programmed according to the battery manufacturer's requirements.
- Battery sense must be included to eliminate voltage drop inaccuracies (Battery voltage sense terminals must directly measure battery voltage at all times. Inaccurate measurements of voltage drop can cause the controller to enter into the absorption stage too early and disconnect loads prematurely during low voltage disconnect (LVD)).
- MPPT Tracking Algorithm should continuously operate with the highest power during bulk charging. The MPPT tracking shall be responsive with full sweeping at all times and operate at the highest point when there are multiple power points on the IV curve due to partial shading or soiling.
- Shall include Charge High Voltage Disconnect protection and Maximum Regulation Voltage settings to prevent overcharging or damage to sensitive loads from high voltage conditions.

Load Control

- Shall include DC Load Control (Low Voltage Disconnect) to protect batteries from over-discharge.

- Shall include Load High Voltage Disconnect protection to prevent damage to sensitive loads from high voltage conditions.
- There shall be custom programmable load control settings for Low Voltage Disconnect (LVD) and Low Voltage Reconnect (LVR) as required for the battery type (lead acid, lithium (LFP) or other).
- There shall be custom programmable load control settings for Low State of Charge Disconnect (Low SOCD) and Low State of Charge Disconnect (Low SOCR) (optional with shunt or BMS accessory)
- There shall be custom programmable settings for delay time (minutes) before LVD or Low SOCD.
- There shall be custom programmable load control settings for Load High Voltage Disconnect (HVD) and High Voltage Reconnect (HVR) provided to protect sensitive loads.
- Shall offer optional dry contact switching for alarm notifications, multiple load control circuits or generator start (this can be established by installing a compatible ReadyRelay relay switch accessory.)
- The optional dry contact shall be able to toggle relays based on real-time operating variables from the solar controller, time-based schedules, manual control, or other programmatic methods.

Reliability

The controller shall be 100% solid-state. Controllers that rely on mechanical relays for charge functionality are not acceptable.

Custom Settings

The charge controller's settings shall be able to be customized and adjusted as required for the system parameters and type of battery (gel, sealed or flooded lead acid, lithium (LFP) or other battery types).
There shall be custom settings available for the following charging parameters.

- Charge voltage regulation setpoints (Absorption, Float and Equalize)
- Absorption time with responsiveness to depth of discharge (DOD)
- Float timeout (aka rebulk)
- Equalize (Boost) time with Equalize (Boost) timeout setting (Max. Time > Absorption Voltage) to prevent partial equalizations for extended periods of time.
- Shall be able to start an Equalize (Boost) charging stage manually with a button or with BlueTooth mobile app (onsite) or digitally (remotely).
- Automatic Equalize (Boost) can be enabled or disabled. Auto Equalize (Boost) custom settings shall include frequency (# of days) between Equalize (Boost) charging stages.
- High voltage disconnect for Solar charging and Loads
- A maximum regulation voltage setpoint limit to protect voltage-sensitive loads
- Date and Time; Internal Clock set manually or set automatically via Network Time Protocol (NTP)

The custom settings shall be programmable with software.
There shall be an option to program the custom settings with a built-in digital display.

Protections

The controller must be equipped with the following electronic protections:

- Solar Input: overload, short-circuit, high voltage warning, nighttime reverse current
- Load Output: overload, short-circuit
- Battery: high voltage
- Reverse polarity (Solar, Battery and load)
- Automatic Heatsink Temperature Limit to protect against overheating
- RTS Battery Sense Terminals: with both short circuit and open circuit protections
- The controller shall continuously perform "Self-Diagnostics" and report any faults or alarm conditions as they happen.

- The controller shall automatically recover from fault conditions and shall not require internal mechanical fuses.
- The controller shall have overvoltage protection with nanosecond response usingTransient Voltage Suppressors (TVS's) rated at least 45004 watts. The solar input, battery and the load output shall be protected.
- The PV array power rating may exceed the controller's Max Nominal Output Power specification by at least 150% without damage. The controller shall also be able to continue operating continuously without exceeding the rated output current of the controller with an oversized PV array.

Environmental Requirements

The controller shall meet the following environmental requirements

- The controller shall be rated for 100% humidity non-condensing conditions with conformally coated circuit boards and stainless steel, marine rated terminals.
- The controller shall be rated for operating temperatures from -30 °C to +60 °C.
- The controller can operate to the rated maximum battery current at 45°C or higher without derating.
- Storage Temperature -40ºC to +80ºC
- Case studies must be available to demonstrate the reliable and long-term performance of the controller in warm and tropical environments.

Digital Meter Display

- The meter interface must be interactive with multiple screens.
- The display shall provide real-time data, historic data, settings information and a self-diagnostic read-out.
- Users shall be able to send commands to the controller via the meter interface.
- Users shall be able to program and adjust controller custom settings via the meter interface.
- Shall have a multi-language display: English, Spanish, French, German

The controller's meter shall display the following information:

- Battery Voltage, Net Battery Current, Load Current, Target Regulation Voltage
- Charge State (Bulk, Absorption, Float, Night)
- Load State (LVD, ON/OFF)
- Alarms, Faults
- Solar Current, Array Voltage, Array Vmp, Array Voc
- Internal Clock Date and Time
- Today's Min/Max Battery Voltages, Charge Ah, Load Ah, Minutes in Absorption/Float/Equalize
- Access to Digital and Graphical Historic Daily Logged data: Min/Max Voltages, Charge Ah, Load Ah, Minutes in Absorption/Float/Equalize

The digital display should have Active Matrix Graphical Meter Specs as follows:

- Auto-Scroll Enable/Disable
- Backlight Timeout
- Auto Return to Main Screen

Communications

Shall support local and remote communications

- Shall support the following protocols: MODBUS RTU, MODBUS TCP/IP, SNMP
- Shall support BlueTooth communications with a mobile device app (Android and iphone)
- The device shall support Serial MODBUS RTU using RS-232, EIA-485 (aka RS-485) and/or USB for programming and monitoring with Open Protocol MODBUS communications.

- The device shall support Ethernet MODBUS TCP/IP, SNMP and an HTTP web interface.
- The HTTP webpage interface shall be capable of monitoring, system control, programmable settings adjustments and firmware updates.

Shall be able to monitor live data and daily logged values for all system parameters including but not limited to the following:

- Battery Voltage
- Charge Current
- Load Current
- Charge State: Bulk (MPPT), Absorption, Float, Equalize, Night, Fault, Disabled
- Operating Array Volts
- Last sweep Vmp/Voc/Pmax
- Target Regulation Voltage
- Battery temperature
- Heat Sink Temperature
- Charge Ah
- Load Ah

The following daily logged values must be stored internally by the controller with daily logged values for the last 100 days or more:

- Min./Max. Battery voltage
- Min./Max State of Charge (SOC) (optional with shunt or BMS accessory)
- Ah Charge/ Load/ Battery Net
- Max./min. Array voltage
- Alarms
- Faults
- The time that the controller has regulated battery charging in absorption, float, and equalize charging stages.

Shall include Network Time Protocol (NTP) with an internet connection.
Daily logged values must be stored internally and viewable with HTML interface or display meter.
SD Card for logging, firmware updates, setpoints
Must be able to to program the custom settings remotely
Must be able to control the device remotely: Enable/ Disable Charging, Enable/ Disable Loads, System Reset and Reset Counters

Mechanical

The controller must accommodate

- The maximum array input and battery wire size shall be 50 mm2 (#1/0 AWG)
- The maximum load wire size shall be 16 mm2 (#6 AWG)
- Wire terminals that are accessible on the front of the controller.
- The IP protection shall be at least IP20, Type 1

Lithium Battery BMS Closed Loop Communications (with ReadyBMS Accessory)

The Solar Controller shall be capable of communicating with a Lithium Battery Management System (BMS) to implement Closed Loop Control and Advanced Battery Monitoring.

- The controller shall support the following battery communication protocols: CANBus and MODBUS over EIA-485

- The controller shall be capable of closed loop control and be capable of providing requested charge regulation voltage and max charge current from the BMS of select lithium battery models.
- The controller shall be able to monitor the battery BMS data including battery voltage, battery current, SOC, battery health and other metrics.
- The controller shall include Low SOC Disconnect/ Reconnect load control settings.
- The controller shall include % SOC Threshold Relay control settings.(optional with Relay accessory)

Shunt Current Monitoring and Integration (with ReadyShunt Accessory)

The Solar Controller shall incorporate precision shunt current monitoring.
Battery Shunt Meter

- Multiple shunts can be installed in the system to monitor different circuits at the same time including the main battery circuit, charge circuits and load circuits.
- The Shunt can be installed on the main battery circuit to provide advanced battery monitoring capabilities including the following.
    - Battery State of Charge (SOC)
    - Daily min/max SOC
    - Battery Current
    - Battery Ah (Daily, Total, Resettable)
        - Battery Net Ah
        - Battery Positive (Charge) Ah
        - Battery Negative (Discharge) Ah
    - # of days since 100% SOC
- The controller shall have the following settings available based on Shunt data
    - Load control: Low SOC Disconnect; Low SOC Reconnect
    - Relay control based on SOC% threshold settings (For loads or genstart)
    - Relay control based on Shunt Current threshold settings

Relay Control (with Relay Accessory)

The Solar Controller shall incorporate a Relay Accessory for dry contact signals and circuit ON/OFF controls.

- The dry contact/ Relays shall be integrated into the controller without external wiring for power.
- The Relays shall include normally open (NO) and Normally Closed (NC) contact switches
- The Relay contact switches shall be rated for at > 6 Amps at < 30 Volts or > 0.5 Amps at < 60 Volts.
- The Relay settings shall be accessible from the controller setup menus in the built-in display or HTML.
- There shall be settings designed specifically for external charging sources (generator start or AC rectifiers with utility backup systems)
- There shall be settings designed specifically for N-Load Control
- There shall be threshold and controller event settings available
- There shall be 7 day, weekly scheduling available to enable/disable Relays and Relay Control settings at different times of the day and week.
- Scheduling shall be based on the internal Clock time

Certification Requirements:

The controller must be compliant with the requirements of the following standards.

Safety

UL1741: Inverters, Converters, and Controllers and Interconnection System Equipment for use with Distributed Energy Sources, Second Edition

CSA C22.2#107.1-01: Power Conversion Equipment

IEC/EN 62109-1: Low Voltage Directive

IEC 62368-1: Audio/video, information and communication technology equipment

IEC60950-1: Information technology equipment

Australia Clean Energy Council Solar Accreditation, PCE device

UKCA Electrical Safety and Electromagnetic Compatibility Regulations

Electromagnetic Standards

US FCC Part-15 Class B

EMC Directives
• Immunity: EN 61000-6-1; EN 61000-6-2
• Emissions: EN 61000-6-3; EN 61000-6-4

The controller shall be manufactured in an ISO9001 certified facility.

All components must be REACH and RoHS compliant

Installation Requirements

The controller shall be installed in accordance with the instructions and requirements provided in the installation manual.

- The Installation shall comply with all local safety and code requirements.
- The minimum wire sizing shall be used as required by local electrical code and a minimum voltage drop of < 2%. (Specify wire sizes up to 35mm (#2 AWG))
- The charge controller shall be installed in a dry and protected area. Do not expose the charge controller to direct sunlight.
- Consideration shall be given to the adequate ventilation and to the ease of replacement in the event of a charge controller failure.
- The charge controller shall be mounted vertically with the minimum clearances as indicated in the installation manual.
- The installation of other equipment in the surroundings of the controller shall always respect the manufacturer’s instructions, in order not to disturb the cooling airflow.
- The charge controller’s heat sink shall be clear of any obstacles to facilitate cooling.